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DISTURBANCES OF THE HEART RHYTHM

WITH REFERENCE TO

THEIR CAUSATION AND THEIR VALUE IN DIAGNOSIS.

presented by author

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REPRINTED FROM THE

TRANSACTIONS OF THE ASSOCIATION OF AMERICAN PHYSICIANS,

SEPTEMBER, 1888.

PHILADELPHIA:
WM. J. DORNAN, PRINTER.

1888.



DISTURBANCES OF THE HEART RHYTHM WITH REFERENCE TO THEIR CAUSATION AND THEIR VALUE IN DIAGNOSIS.

By G. BAUMGARTEN, M.D.,
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INTERMISSION and irregularity of the pulse never fail to attract the attention of the physician, and have been the subject of much discussion. Nevertheless, they are not commonly utilized as a diagnostic resource in a degree at all commensurate with the possibilities; and this partly for the reason that we have not become accustomed to trace their meaning systematically, as we should trace that of a cardiac murmur, of an albuminuria, or any other physical sign; nor do our text-books afford us much help in distinguishing cases in which the character of the heart's rhythm may have a deciding influence in questions of diagnosis or prognosis. In a given case, the mere fact of irregularity, by itself, may have little or no import; yet when attention is given to the character of the irregularity and to its conjunction with certain other conditions of the circulation, it may acquire diagnostic significance of great value. A systematic study and disposition of certain facts, facts well known to you, may possibly secure for us a point of view from which greater precision of interpretation in the individual case becomes possible. If the desire for brevity should betray me into unduly dogmatic language, I trust you will supply the necessary grain of salt.

Above all things is it desirable to group the alterations of rhythm according to their fundamental forms, a demand which the majority of text-books do not even attempt to fulfil. Anomalies of rhythm of the arterial pulse may be conveniently classed under three heads:

I. Mere fluctuations in the frequency of the heart-beat from hour to hour, from minute to minute, or even in half-minutes; the uneven,

unsteady pulse, slowed, as a rule, but easily impressed to greater frequency by slight causes, the so-called *cephalic pulse*, as seen in meningitis and other cerebral disturbances. The most common mode of origin of this pulse is in compression of the brain, which, as it arises, first slows the pulse, then makes it irregular and very frequent. The slowing is attributable to irritation of the pneumogastric centre, the increased frequency to paralysis of the same; *i. e.*, moderate pressure excites, stronger pressure paralyzes it; the irritability of the centre is increased before it is lost. The greatest irregularity (unevenness) of pulse is seen at the time when the centre begins to lose its irritability. While retarded, the pulse is large and full; when frequent, it becomes small and vanishing. During the transition, the pulse-rate is subject to sudden change; the slowed pulse of 60 rises in a few minutes to 100, to 120, to 160, and in a short time again subsides. But, for the time being, the contractions of the heart are not really irregular, though often they are of unequal force.

This form of pulse invariably points to cerebral trouble—compression of the brain from some cause, as from meningitis, from meningeal or cerebral hemorrhage, etc.; local pressure in the region of the medulla oblongata; concussion of the brain, etc.

A similar pulse is sometimes encountered *sub finem vitæ*, as the expression of failing of the vagus centre, either from the asphyctic condition of the brain, or from œdema.

II. Variations in frequency as well as in amplitude of pulse consonant with the respiratory movements, in such manner that the pulse-beats corresponding to inspiration are more frequent and less ample than those which coincide with expiration. This disturbance of rhythm may be carried so far that the inspiratory pulse-waves fail to reach the wrist, or at least to become imperceptible to the finger. Of this form of altered rhythm there are two varieties: (1) that which depends on mechanical compression of the aorta during inspiration, the original *pulsus paradoxus* of Kussmaul, which by him was considered pathognomonic of fibrous mediastino-pericarditis, but which has also been observed in some cases of copious effusion into the pericardium. This variety evidently has nothing to do with the rhythm of the heart, nor, directly at least, with the frequency of its contractions. (2) The very similar pulse resulting from exaggeration of the normal influence of the respiration upon the heart's contractions.

This second form has been observed in stenosis of the air-passages and in capillary bronchitis, *i. e.*, under conditions which exaggerate the respiratory movements themselves.

The pulsus paradoxus of the first variety may be recognized as a sign of fibrous mediastino-pericarditis by the swelling of the jugular veins during each inspiration; the fibrous bands which, when tightened by the inspiratory forward movement of the sternum, press upon the aorta, also compress the superior vena cava at the same time;—as a sign of extensive hydro-pericardium by the permanent swelling of the jugulars. But in the absence of these symptoms on the part of the jugular veins, the pulsus paradoxus is to be interpreted as caused by exaggerated respiratory movements, as has been observed in croup, in paralysis of the crico-arytenoid muscles, in compression of the trachea, and in capillary bronchitis.

With a moderate degree of this form of paradoxical pulse I have become familiar as a harmless phenomenon in sleeping children. It is very likely the pulse to which Stoll refers in the sentence quoted by Nothnagel:¹ “*In pueris dormientibus,*” etc. “In sleeping children, since in them the intermittency is almost a regular thing, it is not to be considered so dangerous.” It is not really an intermittent pulse, however, but, as I can aver from numerous positive observations, a pulsus paradoxus, probably due to the full respiration, whose influence on the innervation of the heart predominates in the deep sleep of the child (more than in the adult) over the other regulating influences on the part of the central nervous system.

III. The third group, finally, comprises all the numerous changes in rhythm more commonly seen in the form of intermittence, of alternating and bigeminous rhythm, and of complete irregularity. They are closely allied among themselves, and result from varied combination of two factors, viz.: (1) the feebleness or suppression of a cardiac systole recurring at longer or shorter intervals with more or less regularity; and (2) variations in the length of the individual pulses, which may also occur regularly or with entire irregularity. The types of pulse which result are mainly these:

¹ Deutsches Archiv f. klin. Med., xvii. p. 190. The entire paragraph reads: “*Pulsus intermittens in una pulsatione pessimus in acutis, et inflammatoris febribus, præsertim si alia vigeant gravia accidentia. Non ita malus, si morbis pectoris superveniat, in quibus familiaris est, aut in morbis senum, aut in plethoricis, aut in pueris dormientibus, in quibus omnibus intermittentia fere cum familiaris sit, non ita pernicioosa testimanda.*” Max Stoll, *Ratio medendi in nosocomio practico Vindobonensi*. Viennæ Austriæ, 1790. Pars vi Sect. i, § 67.

a. The *intermittent* and the *deficient* pulse: at uncertain intervals one beat of the heart is feeble or absent.¹

b. The *pulsus alternans*: full and feeble systoles (high and low pulse-waves) alternate regularly.

c. The *bigeminous pulse*: a full systole is followed, after a brief diastole, by a short and incomplete systole, and this in turn by a long diastole;—if, in such a rhythm, the feeble systole is insufficient to start any pulse-wave at all, there results the phenomenon commonly called intermittent hemisystole of the heart, or more properly *heart-bigeminism*, when two systoles are represented by only one pulse at the wrist; and

d. The wholly *irregular pulse*, *arrhythmia* or *delirium cordis*, produced by both factors combined without rule, both the force of the heart's contractions and the time of their recurrence varying almost at every step.

The four types enumerated are subject to many modifications; among them I will only mention that the alternating and the bigeminous pulse, of a sort of trochæic rhythm, are often converted, by repetition of the feeble systole, into a dactylic meter, when the bigeminous pulse becomes trigeminous (and similarly even quadrigeminous, etc.). These details of rhythm can be satisfactorily recognized only with the aid of the sphygmograph. It is a mistake to think these *allorhythmic* pulses (*b* and *c*) uncommon; in my experience they are of frequent occurrence.

In addition to the four types named, it appears to me that the extremely slow pulse (*pulsus rarissimus*), even if beating at regular intervals, is to be counted among the disturbances of rhythm; in its etiology, in the circumstances under which it is encountered, in its clinical meaning, it has more features in common with arrhythmia, than with a mere change of pulse-rate. Not to speak of the pulse in heart-bigeminism, which is, so to speak, a bigeminous pulse with the feeble twinbeat left out,—I have observed cases in which a regular pulse, say of 30, in a short time became a regular intermitting pulse of 60, in which two full beats were followed by a complete intermission; it is difficult not to infer that in the pulse of 30, each beat was followed

¹ The pulse has been called deficient when the absence of heart sounds proves the actual omission of a systole; intermittent when, as is more common, the pulse-wave started by the systole is too feeble to reach the wrist.

by two intermissions. Lately, within my observation, a young man dying of diphtheritic paralysis of the heart, began by having a frequent and irregular pulse, in which gradually more and more of the feeble beats dropped out, lowering the actual number of palpable pulsations to 67, to 60, to 52, to 36, the intervals becoming more and more regular, until he ended with a very regular pulse of 25 per minute. The very rare pulse of atheroma of the coronary arteries—I have seen it as low as 12 per minute—never *quite* regular, is undoubtedly of this character.

I hold that all types of this group are related to each other not only in form but in origin. Gradual transitions from one to the other are often met with. Nearly all causes of the one may produce the other. They are mainly indicative of *degrees* of disturbance, in such wise that the intenser action of the cause produces the more complete arrhythmia. And if this is true, then it need create no surprise that different forms of irregularity occur under apparently similar clinical conditions; nor is there any warrant for separating even the intermittent pulse from the wholly irregular pulse, so frequent are the transitions between these forms in the same case under only slightly altered conditions, as of posture, of labor and rest, of emotion and mental repose, of cold and heat, before and after food. These transitions nowhere prove themselves so distinctly as the results of *degrees* of noxious influence as in the cases of intoxication by tobacco, coffee, tea, etc. Nevertheless, in judging of the semeiological value of arrhythmic pulses, sufficient account is not taken of the particular forms of irregularity. The usual statement of the text-books that the pulse is irregular must be deemed incomplete.

Moreover, as a symptom of diagnostic or prognostic import, irregularity of pulse acquires its real value only when taken in connection with its frequency and with the degree of arterial tension. An irregular small and soft pulse has a very different meaning from a slow and incompressible pulse showing the same irregularity.

Sommerbrodt held that all forms of allorhythmia and arrhythmia are dependent upon disturbed innervation—*i. e.*, I suppose, upon altered function or structure of either the musculo-motor ganglia of the heart, or the fibres of the vagus or sympathetic, or their cerebral centres. I doubt if this be not too definite a statement in that it excludes the muscular fibres of the heart. Clinically, at least, we cannot divide up

the nerve-muscle apparatus of the heart, so as to decide, in a given case, whether the muscular fibres, the intracardial ganglia, or the connecting nerve-fibres are at fault. And if we cannot, then it is impossible also to prove (or to disprove) that the casual intermission of a beat, for instance, is due to inhibition (*i. e.*, a phenomenon of irritation) or to failure of either nerve, ganglion, or muscle to respond to the normal stimulus (*i. e.*, a phenomenon of depression). With our present knowledge, implicit adherence to Sommerbrodt's statement can only hamper the clinical estimation of the irregular pulse. On the other hand, much present difficulty of clinical interpretation can be avoided by considering the nerve-muscle apparatus as a unit, without attempting to prejudge the question which constituent of it is mainly or primarily affected.

In trying to classify the irregularities of pulse according to the clinical conditions that give rise to them, I shall first dispose of the rarer and less important causes, premising only, that a disproportion between the strength of the heart and the demands made upon it is the fundamental condition of irregularity in most cases, and that, therefore, all other causes are the more potent, the weaker the heart is.

1. One large group of the arhythmias is due to affections of the cardiac centre in the medulla oblongata. Both irritation and depression of the cardiac centre seem capable of disturbing the rhythm of the heart; several conspicuous instances of pulsus alternans and of pulsus bigeminus have come under my observation in cases of cerebral hemorrhage and of softening. Concussion of the brain sometimes causes intermittent and allorhythmic pulses. The more pronounced arhythmia said to have been seen in syncope seems referable to depression of the cardiac centre from cerebral anæmia. Psychological influences are known to be causes of temporary arhythmia, most frequently in the form of intermittence. Whether disease of the trunk of the pneumogastric is ever capable, alone, of causing changes of rhythm is extremely doubtful. Nor is there any clear proof that diseases of the sympathetic fibres, apart from lesions of their centre, affect the rhythmic beat.

- 2 The nerve apparatus of the heart, both cerebral and intracardial, is, however, often disturbed by reflex influences starting from distant organs, as in dyspepsia, in hepatic affections, in some respiratory lesions, and notably in diseases of the kidneys. Apart from the

lesions of circulation secondary to or concomitant with renal affections, we not seldom witness in acute nephritis an irritability of the heart, difficult to explain except by reflex, which shows itself first in great frequency and smallness, and ultimately in complete irregularity of the pulse; in other cases a *pulsus alternans* persists for long periods—weeks.

The arhythmia sometimes seen in such neuroses as pure angina pectoris, chorea, etc., will usually fall under this head. To say that some cases of irregularity of the heart are due to an essential neurosis of the cardiac nerves and ganglia is, of course, begging the question. Of late, distinct organic lesions of the intra-cardiac ganglia have been observed, and upon such these cases may be based; but our knowledge in this direction is fragmentary.

3. A third group of arhythmias is that caused by the action of drugs upon the nerve-muscle apparatus of the heart. The action of the every-day heart poisons, tobacco, coffee, and tea, is well known; a conspicuous instance of a very persistent trigeminous pulse from chronic nicotism is fresh in my memory; but simple intermittence and complete arhythmia are quite as common, indicating either different degrees of intoxication, or different degrees of integrity of the heart itself. In a case of delirium tremens (if you will permit the expression “for short”) from abuse of tea and abstinence from food, I have been able to observe almost all forms of rhythmic aberrations in quick and endless change. *Digitalis*, *belladonna*, *aconite*, *calabar*, and similar poisons induce arhythmia under certain circumstances. A number of other drugs accused of the same action, such as chloroform, tartar emetic, arsenic, seem to produce the irregularity indirectly. Thus, Petrina¹ found that pilocarpin injected under the skin induced an allorhythmia (p. bigeminous) or arhythmia, after every injection, in some individuals “in whom there was reason for considering the muscular or the valvular apparatus of the heart as not quite normal.”

4. For, after all, the majority of cases of disturbed heart-rhythm are owing to changes in the heart itself. The condition common to these cases is incompetency of the heart in the broadest sense,—a disproportion between its motor power and the work to be done. If

¹ Deutsches Archiv f. klin. Med., xxi. pp. 416 et seq., 1878.

observation of its rhythm can aid in determining the condition of the heart as a motor organ, the value of this class of symptoms must be apparent, the more so when the physician realizes that a correct estimate of the vital power of a diseased heart is of even greater importance to him than a minute anatomical diagnosis. Where the irregularity has its origin in the heart itself, the power of its muscle-nerve-apparatus is not, or is no longer, sufficient for its task. This principle is important in deciding the question whether the cause of the arrhythmia is situated in the heart. The arrhythmia of the incompetent heart can be temporarily increased by increasing the demands on the heart; exercise increases the irregularity. More suggestive still is the fact that a moderate degree of allorhythmia which is observed in the erect or sitting posture, often ceases when the patient lies down,—an observation which, within my experience, justifies the diagnosis of its cardiac origin.¹

a. Milder grades of incompetency of the heart result from defective blood supply and malnutrition of the cardiac wall, from long-continued fevers, and from dilatation of the heart. We may expect moderate degrees of irregularity in anæmic and cachectic patients; their small, soft, and usually frequent pulse may remain regular until some additional demand, as by exercise, by some sudden new stimulus, by a sudden rise in blood pressure, renders it intermittent or bigeminous.

The same not seldom happens toward the end of infectious fevers. Landouzy and Siredey² observed in all fatal cases of typhoid fever a myocarditis with atrophy or fatty change of the muscular fibres; above all, in those cases which terminated by collapse, and “in which the symptoms during life had been irregularity of rhythm of the pulse and rapid failure of the heart.” In pneumonia, also, failure of the heart makes itself known by unequal filling of the artery, then intermissions, and at last perhaps entire irregularity of pulse.

Dilatation from sudden severe strain or from habitual overwork, as in the case of military heart-strain, is very sure to produce, at first, a small, soft, accelerated pulse, and later an intermittent or even wholly irregular pulse of great frequency and low tension. When

¹ I have also known the reverse to take place—a bigeminous pulse to disappear whenever the patient rose to his feet—in a case clearly not of cardiac, but of nervous origin.

² *Revue de Méd.*, 1887; quoted in *Practitioner*, January, 1888, p. 64.

dilatation is the attendant of valvular disease, its beginnings are usually compensated by hypertrophy, and the pulse remains regular; but with beginning failure of the heart, the pulse passes more or less gradually through the consecutive degrees of rhythmic disturbance. Even in the best compensated heart the rhythm is affected temporarily by those causes which will produce arrhythmia in hearts weakened through other than valvular affections—by unwonted exercise, mental distress, intercurrent disease, malnutrition. The irregularities of pulse arise sooner, as a rule, in mitral than in aortic disease, sooner in insufficiency of the valves than in stenosis of the orifices. When the limit of compensation has been reached the disturbance of rhythm becomes permanent, and often attains to the highest degree; the cardiac muscle has become permanently incompetent, and undergoes serious nutritive and structural changes. Hence, when in the course of a valvular defect the pulse becomes persistently irregular, it signifies that the hypertrophied heart is now falling a prey to those changes which set a bar to all further compensatory growth; and the greater the previous hypertrophy, the more complete the subsequent arrhythmia—a rule which holds true in enlargement of whatever origin.

b. By far the most frequent cause of complete arrhythmia is that group of organic changes usually classed as myocarditis. This field, upon which I have already trenched, is far too large to harvest in the intended space of this paper; I must confine myself to the more common instances. The structural lesions named chronic myocarditis, when they have reached an extent which enables us to diagnose them, always make the pulse small, frequent, and completely irregular, the irregularity being persistent, not paroxysmal: in the absence of this persistent arrhythmia, indeed, the diagnosis is commonly impossible. No doubt, patients die before this stage has been reached, who had a regular pulse and yet show structural alterations of the myocardium *post mortem*; but such cases are practically beyond positive diagnosis during life.

Acute myocarditis is also characterized by an arrhythmic pulse, very small and often extremely frequent; and its irregularity is an essential factor in the diagnosis.

c. The severer lesions of circulation in the substance of the heart are likewise prolific causes of arrhythmia; above all, sclerosis and narrowing of the coronary arteries, with its almost certain result of fatty

degeneration. The pulse is usually slow, also—sometimes extremely so. While some authors, like Leyden, make small account of irregularity of the pulse in sclerosis of the coronary arteries, I do not remember a single case of it in which the pulse was not either uniformly allorhythmic, or, by spells, completely arrhythmic; and the latter condition I consider much the more common. Extreme slowness of pulse, bradycardia, which is closely allied to the arrhythmias, is also a common event.

The use of the irregular pulse in diagnosis is, of course, greatly assisted by proper attention to its other qualities. The strength of the pulse, its frequency, the persistency of the irregularity, should be thought of in immediate connection with the rhythm itself.

Thus (1) as to compressibility of the pulse: Those arrhythmias which depend upon incompetence of the heart occur in *soft* pulses. With competent, especially hypertrophied hearts, the irregular pulse may be of *normal* resistance (as in arrhythmias from nervous and reflex causes), or even *hard* (as in vaso-renal affections and in early stages of atheromatous disease).

(2) As to frequency of the pulse: The irregular *slow* pulse (excepting the cephalic pulse, due to intra-cranial causes) is probably indicative of fatty heart the result of disease of the coronary arteries. Fatty degeneration of the heart, by itself, does not make the pulse irregular;¹ but when a temporary over-exertion causes such a heart to stumble, the pulse is not only irregular, but also *frequent*, and small, and soft; when the fatty change is the sequel of atheroma of the coronary arteries, the irregular pulse more likely is retarded (but the blood pressure is low, even though the radial artery feels rigid under the finger). Mere weakness of the heart from any cause, when it makes the pulse irregular, also makes it *frequent*.

(3) As to the persistency of the irregular pulse: An arrhythmia which is permanent, never disappearing entirely, points to organic change in the heart itself; one which occurs only when the heart is temporarily subjected to more than ordinary work, indicates the rela-

¹ Many obese persons with fat-encumbered hearts have a slow pulse; whether the store of fat in and about the heart's muscle is the sole and direct cause of the intermittence seems doubtful to me, since I have seldom observed this intermittence in *young* persons of that description. Possibly, the pressure exerted by the exuberant fat has, in time, an effect upon the myocardium similar to that of calcified coronary arteries.

tive incompetency of the heart; when it occurs only in paroxysms, and with absolutely free intervals, it points rather to lesions of the cardiac nerve-apparatus, organic or functional.

Finally it should be said, that in aged people the heart's rhythm is more easily disturbed than in the young; that the irregular pulse is more frequently encountered and of less serious import, on the whole, in advanced age than in youth and early manhood; but that the irregular pulse in very young children is also "*fallacissima res*."

